APPARATUS FOR THREE-DIMENSIONAL ANAEROBIC EXERCISE

Technical Field

The present invention relates to an apparatus for three-dimensional anaerobic exercise capable of attaining stability in three-dimensional motion trajectories necessary for the human body, and more particularly, to an apparatus for three-dimensional anaerobic exercise, which applies a reduction linkage concept, but not a four-rod linkage concept disclosed in Korean Patent Application Nos. 10-2001-0059174 and 10-2001-0078712, previously filed by the inventor of the present invention, for safe three-dimensional motion trajectories in approach to each of various regions of the human body, thereby increasing durability, reducing manufacturing costs, and realizing motion trajectories of various kinds, which are merits of the three-dimensional exercise.

In addition, the present invention relates to an apparatus for three-dimensional anaerobic exercise, which can provide a new approaching method for overcoming lots of limitations of Korean Patent Applications, filed on May 17, 2002 and May 27, 2002 by the inventor of the present invention, in basic configurations such as a rocking angle range of ball joints, and an angular motion range of a handle, and a form change of a horizontal trajectory of a linkage.

Background Art

As shown in FIGS. 7, 9a and 9b of U.S. Patent No. 5769757, exercise using the reduction linkage concept imposes burden on an exerciser's wrists, forearms and shoulders and involves a danger of injury when an angular motion of the handle is simply

applied to the human body since an angle of the handle is subject to the angular motion of a reduction linkage. As a result, the exercise using the reduction linkage concept cannot attain safety and variety, which are characteristics of the three-dimensional motion trajectory.

Disadvantages of the exercise using the reduction linkage concept will be described in more detail as follows. Since a handle shaft and the lower end of the handle are connected directly with each other and rectangular in an "L" shape, the angle of the handle is influenced by the angular motion of a handle linkage. So, as shown in FIG. 9b, angles g and g' are formed at a start point and an end point of the motion, and thereby, the handle is not rectangular to the movement direction of the human body as shown in FIGS. 8a and 8b of the application previously filed by the inventor of the present invention, and in drawings of U.S. Patent Nos. 5997447, 5989165 and 6071216.

Therefore, it is difficult that the prior arts provide a safely three-dimensional exercise as imposing burden on the exerciser's wrists, forearms and shoulders. The reason is that movement of the third linkage of the four-rod linkage is not greatly influenced by the angular motion of the first and second linkages, but the angular motion in the reduction linkage concept is transferred to the angle of the handle as it is.

In more detail, the three-dimensional exercise of the reduction linkage concept has a limitation in realistic approach, but can be applied to a rehabilitation program for a predetermined movement area of the human body since the handle is idly rotated on a bearing as shown in FIG. 13.

The origin of the term "the initial load machine of Japan Tottori-ken" of Japanese Patent (shown in FIG. 13) resides in

the fact that a movement range is applied only to an initial primary section (I) when the movement range is divided into three as shown in FIG. 14: an initial section (I), a middle section (II), and a final section (III).

In the exercise using the reduction linkage concept, in view of the structure of the handle without regard to characteristics of the angular motion of the linkage, the primary load machine of Japanese Patent, which provides an idle rotation, is realistic rather than U.S. Patent No. 5769757 and can provide a safe exercise in spite of the movement within a restricted section.

The L-shaped handle where the handle shaft and the end of the handle are directly connected to each other as shown in FIG. 7 realizes convex motion trajectories from the human body as shown in FIGS. 9a and 9b, and so, cannot realize concave motion trajectories necessary for the human body. The convex trajectories are one of characteristics of the typical angular motion of the handle when the end of the handle is directly connected to the handle shaft. As shown in FIG. 4, as a side of the handle must be directly connected to the handle shaft to obtain the concave trajectories, which are most of the three-dimensional motion trajectories of the human body, the L-shaped handle shows a limitation in realizing the three-dimensional motion trajectories of the human body. As disclosed in U.S. Patent Nos. 5967954, 5562577, 5997447, and 5582564, recently, a great deal of studies and attempts have been made to develop exercise devices for realizing motion trajectories necessary for the human body and safe and stable angle of the handle.

As shown in FIG. 10, the prior art has limitations in realizing a twist angle of 60 to 120 degrees required by the

human body due to the rocking angle (40 ~ 50 degrees) of a restricted ball joint since the ball joint is mounted in a horizontal direction from an auxiliary linkage.

That is, as shown in FIGS. 2 and 6, as the ball joint has a restricted rocking angle (40 ~ 50 degrees) in a vertical direction where a circular motion is carried out, the ball joint can secure the angular motion only by axial mounting suitable for the direction of the angular motion.

Furthermore, as shown in FIG. 7, a handle side lever for the angular motion is not mounted integrally with the handle, but must be mounted opposite to the handle from a bearing housing.

As shown in FIG. 11, if the handle side lever is mounted opposite to a handle frame from a bearing box, a ball joint connection point located at the lower end portion of the auxiliary linkage must be moved to a position lower than a shaft of a handle linkage to obtain a proper angle of the handle.

In this case, since the length of the handle linkage must be shortened or the auxiliary linkage must be enlarged, considering that the human body is 160 ~ 19cm in height and 45 ~ 80cm in arm length, the handle linkage performs lots of angular motions (V, V′) as a basic motion trajectory as the exercise device is enlarged or the handle linkage is shortened, and so, the human body may show rejection symptoms.

Particularly, if the auxiliary linkage is larger than the handle linkage as shown in FIG. 12a, in a section x, an angular motion distance y of the handle is successively increased, but if the auxiliary linkage is shortened as shown in FIG. 12b, the angular motion distance y is successively decreased, so that the length of the auxiliary linkage may have an influence on the

three-dimensional motion trajectories of the human body and the form of the convex or concave motion trajectories in view of a plane as shown in FIG. 5.

Therefore, the length of the auxiliary linkage must be similar to or shorter than that of the handle linkage to set an even or proportional angular momentum of the handle and to realize stable motion trajectories. If the auxiliary linkage is longer than the handle linkage, as the angular motion of the handle is rapidly increased and a movement range (a) is varied according to a figure of the human body, it is difficult to provide proper motion trajectories. The auxiliary linkage and the handle linkage must not be influenced by any factors excepting a distance (d) between the handle linkage and the auxiliary linkage.

As shown in FIGS. 17 to 21, a handle side lever must closely approach the auxiliary linkage in the case where a cross joint is used, which is one of components of the present invention. Otherwise, since the auxiliary linkage must be longer and the position of the lower side lever must be lowered, the lower lever of the cross joint has a complicated structure and there are lots of restrictions in applying angular motion displacement by section.

Moreover, the realization of the motion trajectories for three-dimensional exercise of the prior art have no efficiency because there is no device for various motion trajectories, which are the most greatest merits of the three-dimensional exercise, such as a handle frame A and a handle frame B, which will be described in the present invention later, and there is no means for axially fixing the handle shaft at a proper angle.

That is, U.S. Patent No. 5769757 is nothing but a simply

mechanical approach regardless of the tree-dimensional movement of the human body.

The reduction linkage needs several basic elements for realizing the safe three-dimensional motion trajectories of the handle like the four-rod linkage.

First, as shown in FIGS. 3 and 4, when the handle forms predetermined motion trajectories while carrying out the angular motion, an angle of the handle must be made perpendicularly to the power direction of the human body or according to demands of the human body.

Second, for improved three-dimensional exercise of target muscle of the upper part or the lower part of the human body, as shown in FIG. 2, since a basic motion trajectory for two arms movement must be not horizontal but trapezoidal, the other end of the handle linkage with an angle α or α' must perform a trapezoidal movement in view of a plane.

Third, the apparatus for three-dimensional exercise must resiliently apply not a simply circular motion trajectory but concave or convex trajectories of the handle for a correct exercise to the target muscle because the present invention is provided not for a simple joint movement but a multi-joint movement of the upper part or the lower part of the human body.

Therefore, the end of the handle must be not directly connected to the handle shaft, but first and second handle frames must be connected to the handle shaft and the handle at predetermined angles. That is, the apparatus can induce safe and compatible motion trajectories in various applications if the handle is not directly connected to the handle shaft.

The present invention can overcome problems of overload due

to a single motion trajectory of the conventional two-dimensional exercise apparatus and achieve an effective muscular growth by mounting a plurality of handles to implement various motion trajectories.

To solve the problems of the prior art, a basic setting of the reduction linkage concept will be described hereinafter.

To set the handle safely, as shown in FIG. 2, the handle linkage must be mounted in the form of a trapezoid, and at this time, angles α and α' have the greatest effect in that the handle shaft and the first and second handle frames are fixed with each other at an angle Θ as shown in FIG. 4.

Therefore, the handle is set in a perpendicular direction to a movement direction at a movement start point S as shown in FIG. 3, and a twist amount is about 60 ~ 120 degrees. The angles Θ and α and α' are offset at a movement end point f as shown in FIG. 4, so that the movement is finished at right angles to the movement direction or at an angle necessary for the human body. Therefore, as means for securing a safe angle similar to the angle of the handle formed between the movement start point and the movement end point of the four-rod linkage, mounting means forming the angle Θ with the handle shaft must be provided.

Furthermore, as shown in FIG. 5, to induce concave or convex motion trajectories or various three-dimensional motion trajectories necessary for the human body, the handle is not directly connected to the handle shaft, but is mounted in consideration of characteristics of the angular motion thereof in view of a plane, namely, successive increase and decrease of the angular motion.

Therefore, means for preventing the direct connection of

the handle to the handle shaft, i.e., the first handle frame must be provided.

The greatest merit of the three-dimensional exercise is to apply shock to muscle of the human body along various motion trajectories in various ways. For this, means for mounting two or more handles and fixing means for a proper shape of the handle, i.e., the second handle frame, must be provided.

As shown in FIGS. 7, 11 and 12, as a connection part of the auxiliary linkage is located lower than the handle linkage, the auxiliary linkage must be directly connected to the handle side lever to reduce the absolute length and the width of the linkage. At this time, as shown in FIGS. 2 and 6, ball joints of the auxiliary linkage are mounted according to the movement directions due to a limitation of a rocking angle of the ball joints.

A side lever, which is directly fixed to the handle shaft, is required. As described in the application, which was previously filed on May 27, 2002 by the inventor of the present invention, if the side lever is located at a predetermined position of the handle frame, there may occur interference between the rocking angles of the ball joints as the handle frame is mounted on the handle shaft at a predetermined angle. Particularly, if the handle side lever is located on the handle frame, it is difficult to secure a point for a proper angular motion. Therefore, when the side lever is directly fixed to the handle shaft in a direction of the handle frame from a bearing housing, a safe three-dimensional movement of the handle can be induced.

The second handle frame can attain safety of the handle, which is provided by the four-rod linkage, as being fixed to the

handle shaft at the angle θ. Since a side of the handle is not directly connected to the handle shaft, as shown in FIG. 5, the first handle frame is required as the means using the successive increase and decrease of the angular motion of the handle for the convex or concave motion trajectories necessary for the human body in view of the plane.

Particularly, the second handle frame for mounting two or more handles and for providing the shape of proper motion trajectory is connected to the first handle frame at the angle θ.

The first and second handle frames must be fixed only to the handle shaft when the handle linkage performs the angular motion at the angles α and α' for an independent trapezoidal biaxial movement. At this time, the handle shaft must be also fixed to the upper end of the handle linkage at angles β and β' as shown in FIG. 1.

For this, the bearing box must be fixed to the upper end of the handle linkage at the angle β or β'. Particularly, to increase durability of a weight training apparatus of heavy load, bearings must be arranged at a proper distance from the handle shaft because direct arrangement of the bearing onto the handle linkage may reduce durability or increase volume of the handle linkage. So, the bearing box is required to provide durability of the handle linkage and a proper angle setting of the handle shaft for forming motion trajectories necessary for the human body.

Disclosure of Invention

Accordingly, the present invention has been made in view of the above problems, and it is an object of the present invention

to provide an apparatus for three-dimensional anaerobic exercise, which is another approach of apparatuses for three-dimensional exercise using four-rod linkage (Korean Patent Application Nos. 10-2001-0059174 and 10-2001-0078712 previously filed by the inventor of the present invention), and which can apply safe and efficient motion trajectories realized by the four-rod linkage to a reduction linkage concept.

The four-rod linkage for realizing the three-dimensional motion trajectories has an advantage in that an angle of a handle can be maintained uniformly in a movement direction of the human body as an angular motion of the four-rod linkage is not influenced by rotation of the handle. However, the four-rod linkage is not good as having complicated structure and form, a heavy volume, and expensive manufacturing costs.

The reduction linkage concept proposed as an alternative measure of the four-rod linkage may impose a heavy burden on an exerciser's wrists and forearms as the angular motion of the handle linkage has an influence on the angle of the handle.

Therefore, in the reduction linkage concept, to secure safety realized by the four-rod linkage, it is required to analyze characteristics of movement of the upper part of the human body and apply kinematics in connection with angle displacement of the handle during the angular motion.

When the exerciser does exercise, the upper and lower parts of the human body form not parallel motion trajectory but trapezoidal motion trajectories. At this time, strictly speaking, the trapezoidal motion trajectories must be concave or convex motion trajectories when they are seen in view of a plane from the human body. Therefore, the apparatus must form concave or convex motion trajectories to exactly approach target muscle,

and realize smooth and safe motion trajectories of the exerciser's shoulders, arms and wrists.

To this end, a first handle frame is required for avoiding a direct connection between a handle shaft and a side of the handle and for setting the handle at a proper position, and a second frame is also required for forming a predetermined angle.

When a handle linkage is axially fixed at a predetermined angle, the upper bearing box of the handle linkage is also maintained at a predetermined angle under the influence of the angle of the handle linkage. Particularly, the angle between the handle shaft and the handle frame is the most influenced by the axially fixed angle of the handle linkage.

A distance of the first handle frame and an angle between the first handle frame and the second handle frame are influenced by the axially fixed angle of the handle linkage.

As described above, the components must be mounted kinetically and dynamically, and a number of handles must be mounted on the second handle frame.

At this time, a handle side lever is fixed to a side of the handle centering a bearing box, and separated from the handle frame. The reason is that there may occur interference within a range of a rocking angle of ball joints of the lever since the first and second handle frames may be connected to the handle shaft at a specific angle, and the lever may not be located on the handle frame.

In the above structure, gearing means and a damper in stead of an auxiliary linkage can be utilized to enlarge the angular motion range of the handle. Furthermore, a cross joint mounted on the lower shaft can realize wide three-dimensional motion trajectories, and has a guide linkage for freedom and specified

twist structure. The combination between the cross joint and the guide linkage can realize motion trajectories, which were not realized by the conventional reduction trajectories.

At this time, the shape of the handle side lever and the front lever of the frame, which are connection parts of the auxiliary linkage using the cross joint, cannot suggest a realistic alternative method in terms of the position of the handle side lever disclosed in the U.S. Patents. Particularly, shafts of the ball joints for changing a forward angular motion to a laterally angular motion of the auxiliary linkage must be arranged perpendicularly to each other.

As described above, the apparatus for three-dimensional anaerobic exercise according to the present invention can provide three-dimensional motion trajectories suitable for the human body and allow the human body to do more improved exercise.

Brief Description of Drawings

Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of an apparatus for three-dimensional anaerobic exercise according to a preferred embodiment of the present invention;

FIG. 2 is a plan view of the apparatus for three-dimensional anaerobic exercise;

FIG. 3 is a side view showing a motion trajectory of the apparatus for three-dimensional anaerobic exercise;

FIG. 4 is a plan view showing the motion trajectory of the apparatus for three-dimensional anaerobic exercise;

FIG. 5 is a view showing concave and convex motion

trajectories of a handle of the apparatus for three-dimensional anaerobic exercise;

FIG. 6 is a front view of the apparatus for three-dimensional anaerobic exercise;

FIG. 7 is an exemplary view showing a used state of U.S. Patent No. 5769757 as a prior art;

FIGS. 8a and 8b are perspective view of a conventional apparatus for three-dimensional anaerobic exercise using a four-rod linkage, which was previously filed by the inventor of the present invention;

FIG. 9a is a plan view showing motion trajectories of the prior art;

FIG. 9b is a side view showing the motion trajectorie of the prior art;

FIG. 10 is a front view showing an operation state of the prior art;

FIG. 11 is a side view showing the operation state of the prior art;

FIGS. 12a and 12b are brief side views for showing an operation principle of the present invention;

FIG. 13 is a perspective view showing a primary load machine of Japanese Patent as a prior art;

FIG. 14 is a side view showing a resistance section of the primary load machine of Japanese Patent;

FIG. 15a is a perspective view of a first auxiliary linkage using a damper according to the present invention;

FIG. 15b is a side view of the auxiliary linkage using the damper according to the present invention;

FIG. 16a is a perspective view of a bearing box using a gearing method according to the present invention;

gearing method according to the present invention;

FIG. 17a is a perspective view showing a shaft structure using a cross joint according to the present invention;

FIG. 17b is a side view showing the shaft structure using the cross joint according to the present invention;

FIG. 18 is a perspective view showing an embodiment where the shaft structure using the cross joint and the bearing box using the gearing method are combined;

FIG. 19 is a perspective view showing a state where the shaft structure using the cross joint and a second auxiliary linkage are combined;

FIG. 20a is a front view of FIG. 19;

FIG. 20b is a side view of FIG. 19;

FIG. 21a is a plan view showing an installation position of fixing fragment fixed on a base frame of FIG. 19; and

FIG. 21b is a plan view showing motion trajectories formed by FIG. 21a.

Best Mode for Carrying Out the Invention

The present invention provides an apparatus for three-dimensional anaerobic exercise, which can overcome restrictions of a conventional reduction linkage in applying three-dimensional exercise by providing an angular motion of a handle suitable for movement directions of the human body as in three-dimensional motion trajectories of four-rod linkages of Korean Patent Application Nos. 10-2001-0059174 and 10-2001-0078712, which were previously filed by the inventor of the present invention, and realizing stable motion trajectories, thereby allowing the human body to carry out three-dimensional exercise

more safely and effectively.

The present invention will now be described in detail in connection with preferred embodiments with reference to the accompanying drawings.

As the three-dimensional anaerobic exercise apparatus 1, FIG. 1 shows an apparatus for breast exercise of the upper part of the human body according to a preferred embodiment of the present invention.

The three-dimensional anaerobic exercise apparatus 1 includes an I-shaped base frame 2 and a tower 3. A seat 4 is mounted on the base frame 2. Handle linkages 5 are inclinedly mounted at right and left sides of the base frame 2 via bearings 6 in such a manner as to form an angle α in front of the seat 4, so that the handle linkages 5 can perform an angular motion in back and forth directions. A bearing box is mounted on the front end of the handle linkage 5, and first and second handle frames 8 and 9 are mounted in such a manner as to be rotated by a handle shaft 10.

The first handle frame 8 is connected to the handle shaft 10, and the second handle frame 9 is connected to the first handle frame 8 at an angle Θ. At this time, a side lever 11 of the handle is fixed between the first handle frame 8 and the bearing box 7 at a predetermined setting angle (which can be adjusted according to moving parts of the human body) formed with the first handle frame 8 in directions of the first and second handle frames 8 and 9 from the bearing box 7.

The upper end portion of an auxiliary linkage 12 is connected to the handle side lever 11 via a ball joint 13, and a ball joint 13a is mounted on the lower end portion of the

auxiliary linkage 12 in such a manner as to form a distance d from a fixed lever 14 fixed to the lower end of the front side of the base frame 2.

an auxiliary linkage (12) connected at an upper end to the handle side lever (11) via a ball joint (13) and mounted at lower end on a fixed lever (14) fixed to the lower end of the front side of the base frame (2) via a ball joint (13a) to form a distance (d).

After all, when the handle linkage 5 carries out the angular motion using a distance difference between the handle linkage 5 and the auxiliary linkage 12, the handle shaft 10 performs a circular motion, so that the handle 15 mounted on the first and second handle frames 8 and 9 provides a three-dimensional motion trajectory as shown in FIGS. 3 and 4 to allow the exerciser to do three-dimensional exercise.

That is, as shown in FIGS. 1 to 4, the handle linkage 5 is axially mounted on the base frame 2 at the angle α or α′ for trapezoidal and angular motion, and the auxiliary linkage 12, as shown in FIG. 1, is connected to the fixed lever 14 of the base frame 2 via the ball joint 13a at the predetermined distance d from the front side or the rear side of the lower portion of the handle linkage 5. At this time, the ball joint 13a is axially mounted in the same direction as the angular motion of the handle linkage 5, namely, in a direction that the ball joint 13a located at the lower portion of the auxiliary linkage 12 is perpendicular to the ball joint 13 located at the upper portion of the auxiliary linkage 12.

After that, as means for axially mounting the handle shaft 10 at angles β and β′, the bearing box 7 is fixed on the upper

end of the handle linkage 5.

The handle shaft 10 is axially mounted to the bearing box 7, and the first handle frame 8 is fixed to an end of the handle shaft 10 in such a manner that an end of the handle 15 is not directly connected to the handle shaft 10. The second handle frame 9 is connected to the handle shaft 10 at the angle Θ in such a manner as to adjust an angle of the handle 15 or to mount two or more handles 15.

The handle side lever 11 is fixed between the bearing box 7 and the first handle frame 8 in such a manner as to maintain a predetermined angle with respect to the first handle frame 8. The handle side lever 11 is connected to the auxiliary linkage 12 via the ball joint 13, and the ball joint 13 performs a smooth angular motion similar to an angular motion of the handle shaft 10.

Based on the three-dimensional anaerobic exercise apparatus 1 according to the present invention, the components of the present invention for realizing the safe motion trajectories necessary for the human body in view of the side and plane as shown in FIGS. 3 and 4 will be described in more detail.

First, the angle α and α' of the handle linkage 5 is to obtain a trapezoidal structure for multi-joint exercise of the human body, and to induce organic composition with other components.

In case of an apparatus for exercise of the upper part of the human body, when the handle linkage 5 is axially fixed at the angle α and α' and performs the angular motion at angles r and r', for the angular motion of the handle suitable for the human body, an angle range of r + r' does not exceed 65 degrees

and a motion trajectory a of the upper part of the human body does not exceed 65cm. Therefore, the length b of the handle linkage 5 is at least 60cm or more.

When the handle linkage 5 is moved at the angle of r + r′, as shown in FIG. 3, the angle r has an influence on the angle Θ formed between the handle shaft 10 and the second handle frame 9 when the handle is located at a side of the human body. On the other hand, as shown in FIG. 4, the angle Θ is influenced by the angle α when the handle 15 is located in front of the human body.

After all, when the angles α, β and r, the length b of the handle linkage 5, and the motion trajectory length a of the upper part are in organic relationship one another, the reduction linkage can realize safely three-dimensional motion trajectories in view of the plane and side.

To obtain motion trajectories necessary for the human body′s wrists, arms and shoulders, when the motion trajectory is seen from the side view as shown in FIG. 3, the angle Θ is required for offset of the angle r, and when the motion trajectory is seen from the plane view as shown in FIG. 4, the angle α is required for offset of the angle Θ.

To improve movement of the target muscle by realizing the safely three-dimensional motion trajectories more suitable for the human body, the successive increase and decrease of the angular motion of the handle 15 is used.

To realize the concave motion trajectories from the human body as shown in FIGS. 4 and 5, the motion trajectories formed in view of the plane are the concave or convex motion trajectories from the human body according to the position of the start point S as shown in FIG. 5. To apply the motion

trajectories to the human body, the first handle frame 8 for connecting the handle shaft 10 and the second handle frame 9 at the angle Θ must be provided for constructing the handle 15 corresponding to portions relative to the start point S and the end point f, and the first handle frame 8 must be fixed to the handle shaft 10 for the safe motion trajectories.

As shown in FIG. 4, the apparatus requires means for mounting two or more handles 15 for the safe motion trajectories, differently from a two-dimensional apparatus, which simply changes only the form of the handle.

That is, a first handle 15a starts the movement at a range wider than a second handle 15b and has an angular motion of 60 ~ 120 degrees, but finishes the movement at a range narrower than the second handle 15b. So, the first handle 15a can increase approach of the target muscle and reduce approach of other muscle in comparison with the second handle 15b, so that the human body can do exercise in various motion trajectories using one apparatus.

The first handle frame 8 is provided for mounting of two or more handles 15, and the second handle frame 9 is connected to the first handle frame 8 at the angle Θ for forming the angle Θ of the handle 15.

A kinetic approach of the components is required for the organic combination of the three-dimensional motion trajectories.

First, differently from FIG. 10 (prior art), as shown in FIG. 5, the ball joint 13a mounted on the lower end portion of the auxiliary linkage 12 is axially mounted similar to the angular motion direction of the handle linkage 5, and the ball joint 13 mounted on the upper end portion of the auxiliary

linkage 12 is also axially mounted similar to the angular motion direction of the handle 15, so that the ball joints 13 and 13a having the restricted rocking angle (40 ~ 50 degrees) to the movement direction can absorb the angular motions of the handle linkage 5 and the handle 15 when the handle linkage 5 and the handle 15 perform wide angular motions. After all, the shaft of the handle 15 and the shaft of the handle linkage 5 are operated in a cross way to each other, and the ball joints 13 and 13a are operated in a cross way to each other to absorb the angular motion of the handle 15 and the handle linkage 5, and so, the angular motion range of the handle necessary to the upper part of the human body must be set from 60 degrees to 120 degrees.

Differently from FIG. 10 (prior art), as shown in FIG. 6, for the safely three-dimensional motion trajectories, the length of the handle linkage 5 and the length of the auxiliary linkage 12 are similar to each other or the same. For this, the ball joint 13 located at the upper end portion of the auxiliary linkage 12 is mounted in such a manner that the handle side lever 11 is fixed to the handle shaft 10 in the direction of the handle 15 from the bearing box 7.

Otherwise, as shown in FIG. 13, the angular motion of the handle 15 is increased or decreased. If the auxiliary linkage 12 is enlarged as shown in FIG. 11, it is difficult to obtain the stable angular motion of the handle 15.

On the other hand, if the auxiliary linkage 12 is somewhat shorter than the handle linkage 5, the properties of the angular motion of the handle 15 and the compensation can be attained.

As shown in FIG. 1, to apply various motion trajectories necessary for the human body, the bearing box 7 is fixed to the front end of the handle linkage 5 at the angle β or β″, and at

this time, the handle shaft 10 is axially fixed at the angle β or β''.

Considering peculiarity of the human body, influence of the components, and restrictions of range, the angle of the bearing box 7 fixed to the handle linkage 5 can be controlled to β or β''.

For instance, if the angles r and θ do not correspond to each other, the angle of the handle shaft 10 is controlled to β for approach to the human body, and if the angles α and θ do not correspond to each other, the angle of the handle shaft 10 is controlled to β' for obtaining the motion trajectories necessary for the human body.

In the above, the basic structure of the three-dimensional anaerobic exercise apparatus 1 is described. Hereinafter, referring to FIGS. 15a to 16b, means for increasing the restricted angular motion will be described in detail.

As shown in FIGS. 15a and 15b, a damper 16 is mounted in place of the auxiliary linkage 12 to increase the angular momentum of the handle 15 and resistance of the exerciser within the restricted section. An adjustable screwing part 17, which uses a male and female screwing method, is used so as to control the angular motion range of the handle 15.

In FIGS. 15a and 15b, the angular motion more than 180 degrees is impossible, but as shown in FIGS. 16a and 16b, the upper and lower bearing boxes 7 are in close contact with each other, and the spur gears 19 and 20, which are axially fixed to the handle shaft 10 and the side lever shaft 18 in respective, are connected to the upper and lower bearing boxes 7 respectively, so that the angular motion can be increased by the gear ratio.

The handle shaft 10 and the side lever shaft 18 must be axially mounted in parallel with each other, and if the handle shaft 10 and the side lever shaft 18 have the same trajectory in, the basic three-dimensional motion trajectories, as shown in FIGS. 16a and 16b, the fixed lever 14 of the base frame 2 is located in the opposite direction to the shafts.

FIGS. 17a and 17b show an example where the cross joint 21 is applied for allowing the handle linkage 5 to perform both a back and forth movement and a lateral movement. A shaft 21a of a side of the cross joint 21 is axially mounted on the bearing 6, and a shaft 21b of the other side is axially mounted to the lower end portion of the handle linkage 5.

A connection lever 22 is axially fixed to an end portion of the front side of the shaft 21a, and the other end portion of the shaft 21a is connected to the lower end portion of the auxiliary linkage 12 via the ball joint 13a. At this time, the connection lever 22 is in an L shape for absorbing the rocking angle of the ball joint 13a.

Meanwhile, FIG. 18 shows an example where the spur gears 19 and 20 axially mounted to the bearing boxes 7 of FIGS. 16a and 16b and the cross joint 21 of FIGS. 17a and 17b are combined with each other.

In FIG. 19, fixing pieces 23 and 24 are mounted on the handle linkage 5 and the base frame 2 in the state of FIGS. 17a and 17b, and another auxiliary linkage 27 is mounted between the fixing pieces 23 and 24 via ball joints 25 and 26. The auxiliary linkage 27 is to induce the three-dimensional motion trajectory of the handle linkage 5 using the characteristics of the cross joint 21.

Referring to FIGS. 20a and 20b, the trajectory of the

handle 15 can induce the trajectory as shown in FIG. 21b according to the position of the fixing pieces 24 shown in FIG. 21a.

Industrial Applicability

As described above, the conventional two-dimensional anaerobic exercise apparatus cannot provide a safe motion trajectory necessary for the human body as using single motion trajectory and single resistance, but the three-dimensional anaerobic exercise apparatus according to the present invention can safely apply resistance to the human body by using means such as a cam.

The three-dimensional anaerobic exercise apparatus according to the present invention can completely control the angular motion of joints of the human body, and so, can control various patterns, such as successive increase and decrease of resistance as providing the safe motion trajectories.

Furthermore, the present invention can overcome the restrictions and overload problem of the two-dimensional anaerobic exercise apparatus as having two or more handles 15a and 15b. That is, the present invention is very effective to muscle growth by applying various impacts to the muscles as providing a safe joint structure at low load.

The four-rod linkage concept proposed in the application previously filed by the inventor of the present invention secures the safe motion trajectories, but has several problems in that a manufacturing process of the apparatus is very complicated and manufacturing costs are too expensive. As a result of studies of the four-rod linkage, restrictions of reduction can be overcome by approach of the reduced-rod linkage

concept. So, the reduced-rod linkage concept can be commercially used since the manufacturing process is simple and the manufacturing costs are inexpensive even though the reduced-rod linkage concept requires various data for motion trajectories corresponding to those formed by the human body.

In the conventional reduced-rod linkage concept, the entire size of the linkage is large because the handle has a restriction in change of angle. However, the present invention can increase approach to the human body through a free change of angle of the handle, can considerably reduce the entire size of the linkage, and increase convenience when the exerciser seats on the seat of the apparatus.

In addition, the conventional two-dimensional anaerobic exercise apparatus has a restriction in the motion trajectories of the handle in view of the plane, and cannot obtain the angle necessary for the human body as the angle of the handle is influenced by the angular motion of the handle linkage. However, the present invention can realize the motion trajectories necessary for the human body by providing means for utilizing various data of the three-dimensional motion trajectories provided by the conventional two-dimensional anaerobic exercise apparatus or the conventional three-dimensional anaerobic exercise apparatus having the four-rod linkage, thereby contributing to well-balanced growth of the human body.

While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.